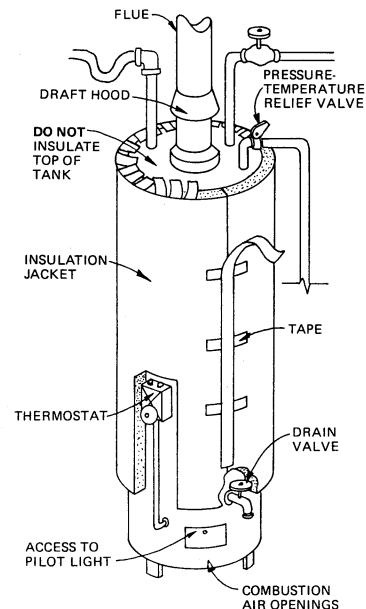
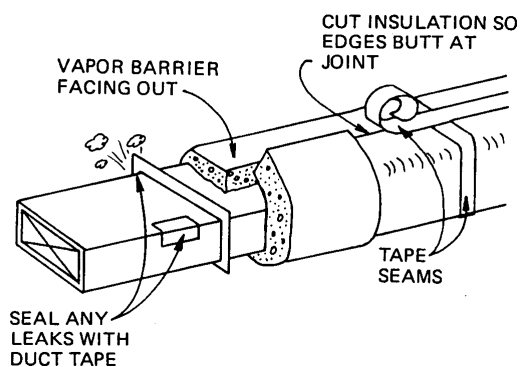
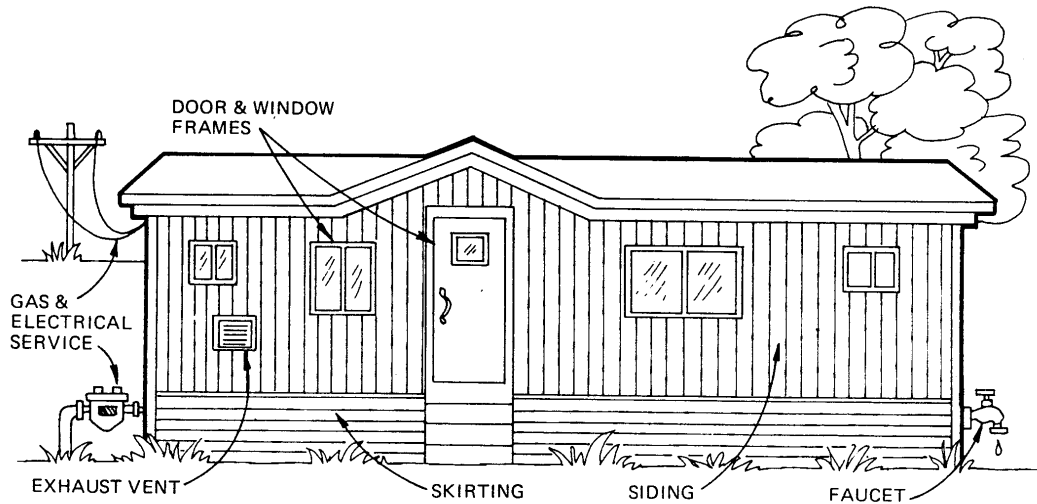


The Energy-Efficient Manufactured Home



A Guide for Missourians
Missouri Department of Natural Resources
Energy Center

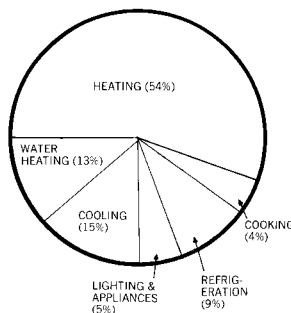
Introduction

Approximately 336,000 Missourians live in manufactured homes. They number 15 percent or more of the housing stock in 35 of the 114 counties, and approximately 8,000 new units are added each year. Most are never moved once they are installed on a site.

How energy-efficient is a manufactured home? There are two basic categories: homes built before mid-1976 and homes built since June 15, 1976, when all manufactured homes produced in the United States were required to meet the U.S. Department of Housing and Urban Development's Manufactured Home Construction and Safety Standards Code.

The code requires that new manufactured homes have:

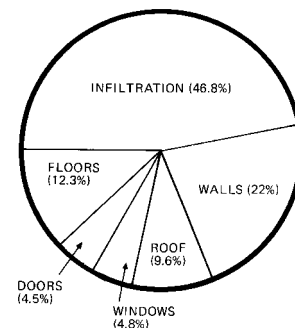
- met maximum heat loss criteria,
- ceiling and wall vapor barriers,
- construction that limits air and water infiltration,
- storm windows or double-pane glass,
- minimum furnace recovery efficiency of 75 percent,
- insulated heating ducts,
- ID number, HUD data plate and heating certificate, and
- other quality and safety features.



1. Estimated Average Missouri Manufactured Home Energy Use. The biggest energy users in Missouri manufactured homes are space heating, cooling and water heating. Electricity is more than twice as expensive as natural gas or propane in the end-use; therefore, owners of homes heated with electricity may spend a greater percentage of their total energy dollars on heating than shown in the chart. Energy costs and equipment end-use efficiencies vary from area to area.

The unique energy-related problems of manufactured homes must be considered. An adequate foundation and proper leveling are critical. The underside may be exposed to outside air temperature and wind conditions. Excessive moisture buildup may be a problem, particularly in cold and humid areas. Wall area, and consequent wall heat loss, is greater relative to floor area than in site-built homes. The walls and ceiling are difficult to reinsulate. In addition, there is inadequate thermal mass for passive solar applications, and there is often insufficient space and/or structural strength for active solar systems to be mounted on roofs.

However, these problems are not insurmountable and frequently can be solved easily. Whether you live in a home built before or after 1976, there are many ways you can reduce the amount of energy you use.



2. Typical Manufactured Home Heat Loss. Most of a manufactured home's heat loss is air infiltration. This chart is for a manufactured home with R-19 ceiling, R-11 walls, and R-13 floors, typical of current construction.

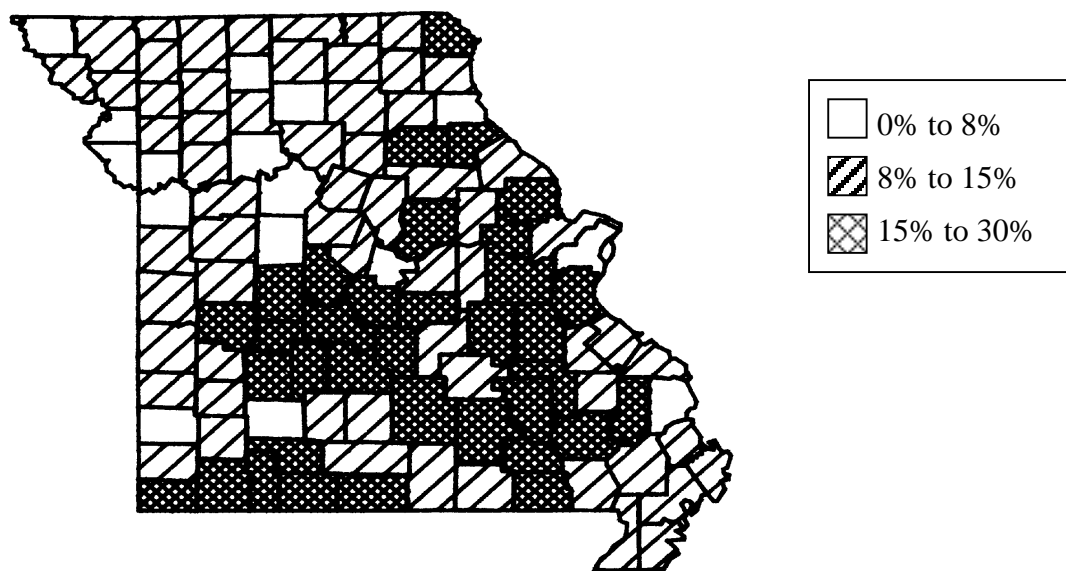
Energy Consumption and Costs

The energy for heating, cooling and providing hot water to a family living in a manufactured home is typically about 85 percent of the total energy consumed by that home every year. Most of the money is spent to operate the heating system. This includes the energy used to heat the home and the energy wasted in heating air that goes out the doors, windows and cracks, as well as up the flues.

The energy consumption pie charts on page one may give you a better idea of where your energy actually goes and may help you decide where to conserve first. (*Illus. 1 and 2.*)

This booklet is primarily for manufactured home owners, although many of the energy-saving suggestions will be useful for renters as well. The major part of the booklet deals with energy conservation, followed by a few solar options and remodeling and building addition ideas—things you might consider once you have taken all the fundamental energy conservation steps.

At the back of this booklet, you will find a checklist of energy-saving actions you can take, grouped by cost and effectiveness, along with some sources of additional information.



Manufactured Homes as a proportion of all occupied housing, 1990.

Preliminary Steps

Selecting a Manufactured Home

Here are some important questions to ask when shopping for a manufactured home:

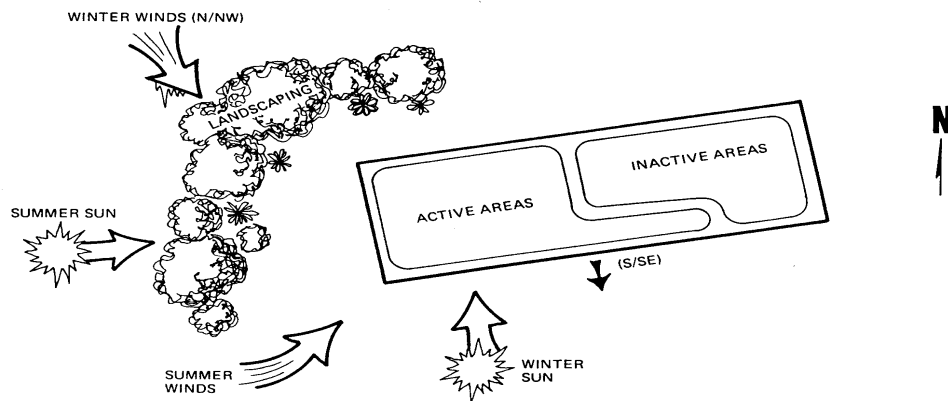
1. Are the ceiling, walls and floor well insulated?
2. Are double-glazed windows and/or storm windows provided (or can they be easily added)?
3. Are insulated exterior doors provided (and/or storm doors)?
4. Is there a vapor barrier in the ceiling, walls and floor?
5. Does the manufactured home appear to be tightly constructed, that is—
 - ◆ Is it well sealed?
 - ◆ Will it hold up to being transported to your site?
 - ◆ Are panels likely to come loose during a strong wind?
 - ◆ Are gaps filled and sealed where pipes, vents, etc. penetrate the exterior shell, and are there foam pop-open gaskets in the bathroom fan vent?
6. Is there an energy-efficient water heater?
7. Check the manufactured home's data plate (usually located inside a closet or cabinet). Are the wind, roof load (snow) and climatic zones correct for your area?
8. Is the furnace properly sized (not too big or too small) for the winter weather conditions

at your site? You may want to consult a heating specialist.

Site Considerations

The location of buildings, along with hills, trees and other natural barriers to the wind and sunshine should be considered before selecting the site for your manufactured home. The best site is one that provides as much *natural* summer coolness and winter warmth to your home as possible. Consider planting trees that shade your home in the summer (particularly on the west side), but allow the sunshine to come through to the southerly sides in the winter. Also, locate your home so that landscaping and other wind barriers block the prevailing winter winds, yet channel the prevailing summer winds for free cooling.

The orientation of your home also is important. Orientation is simply the direction the home is placed on the site in relation to the sun and the prevailing wind. The home will be exposed to more warmth in the winter (and less in the summer) if the long side (with the most windows and usually the main entrance) faces to the south or slightly southeast. Active areas of the home—those that are used a lot during the day, such as the living room or kitchen—should be located on the south-facing side of the home. (Illus. 3.)



3. Orientation. In winter, an ideal orientation would expose the manufactured home to the sun while blocking the worst of the winds. In summer, it would expose the home to the winds while blocking the worst of the sun.

How to Make Your Mobile Home More Energy Efficient

Within the sections ahead (such as "Insulating Your Manufactured Home"), energy-saving projects are generally listed in the order of cost-effectiveness. The checklist in the back of the booklet also shows the cost-effectiveness of measures in perspective.

No-Cost Measures

There are many things you can do to save energy in your manufactured home without spending a penny. For instance:

Thermostat—In cold weather, keep the thermostat setting as low as you can and still be comfortable. Reduce it further at night. In warm weather, reverse the procedure.

Windows and Doors—On cold days, open window shades and drapes on the south side of the home to let in the sun's warmth. On cloudy days and after sunset, keep drapes or insulated shades closed. Keep doors closed as much as possible.

Appliances and Lighting—Use your stove, refrigerator, and other appliances as efficiently as possible. Turn off lights when they are not needed. See the checklist in the back of this booklet for numerous other no-cost measures, some of which are covered in more detail in the pages ahead.

Caulking and Weatherstripping

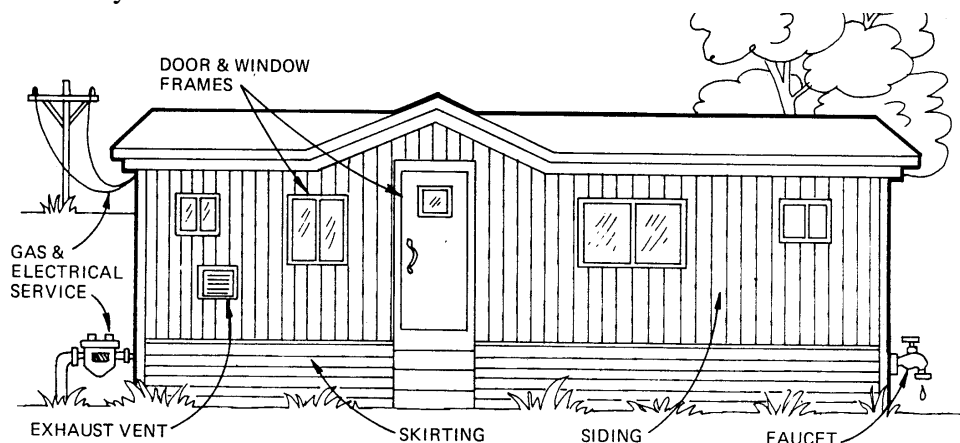
During both the heating and cooling seasons, it can be costly to have air leaking (or "infiltrating") in and out of your home.

Manufactured homes are susceptible to air infiltration because they are usually installed off the ground, the outside walls are sheathed with panels, and exterior building components have been jarred around when the unit was transported.

The best time to check for air infiltration is on a windy day when you can see not only cracks and holes, but feel the air moving in and out. Places to check include:

- ◆ Around door and window frames.
- ◆ Wherever penetrations through the manufactured home envelope exist, including: gas, electric, water, telephone, and TV cable penetrations; heating and cooling system flues, supply air ducts, and combustion air ducts; and ventilation fan ducts. (Illus. 4.)
- ◆ At edges and seams of the belly board.
- ◆ Wherever the interior finish is penetrated, as for plumbing fixtures (especially the bathtub) and electrical outlets, switch plates, and fixtures.
- ◆ At seams, joints, and holes in the interior paneling, including wall-floor, wall-ceiling, and wall-wall junctures.

There are several things you can easily do to stop air infiltration: caulking, weatherstripping, installing gaskets behind electrical outlet and light switch plates, and sealing kitchen and bathroom vents.



4. Sources of Infiltration. Door and window frames and penetrations for utilities, window air conditioners, and exhaust fans are the worst sources of infiltration.

Caulking

Caulk is a compound used for filling cracks, holes and joints on the inside and outside of the home. Apply caulk where any two different non-moving materials meet, such as a window frame and the wall paneling. It can be done with a few simple tools.

You will find many caulking compounds on the market that vary greatly in cost, durability and ease of application. Common ones are listed in the chart.

Caulking compounds are available from hardware stores, building suppliers, lumber yards and other dealers. Be sure that the caulk you select will remain elastic after it dries. This allows for expansion and contraction of the different adjoining materials as well as for normal movement and settling of your manufactured home.

Before you begin to tighten up your manufactured home—particularly before caulking and weatherstripping—be sure it is on a solid foundation and properly anchored and leveled.

Because of its durability and reasonable cost, a good quality latex caulk is suggested for

the interior of the home and areas that don't move and shift very much. Silicone may be the best buy for the exterior because it has a lot of elasticity.

The surfaces to be caulked should be clean and dry, free from flaking paint, loose dirt and deteriorated caulk. Before caulking, apply a filler material (e.g., oakum, cotton, fiberglass) to extra-wide cracks. Caulk should be forced into the crack or opening—deeply enough and widely enough so you are certain that the caulk adheres to both sides completely. It should then be smoothed out on the surface. Caulk should not be applied in cold weather—the temperature should be above 40°F.

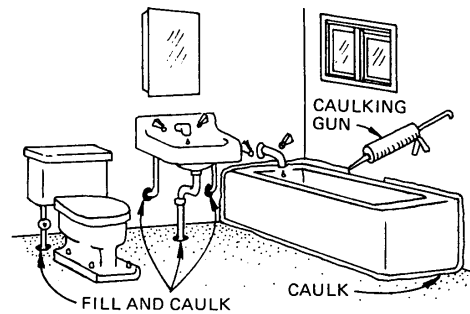
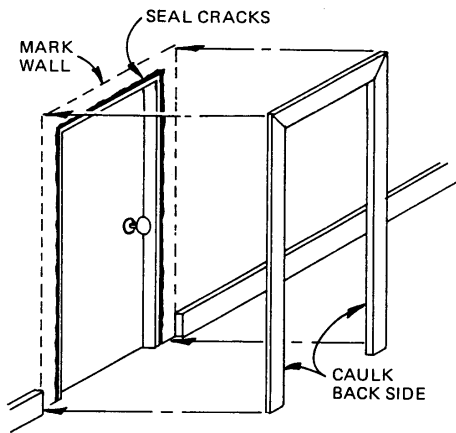
Because of the need for ventilation of the *exterior* wall and roof siding to remove any accumulated moisture from the insulation cavities, on the exterior, caulk should be applied only to prevent water entry such as rain. Do *not* caulk seams and joints on the exterior.

On the *interior*, the most important points to caulk are around door and window frames and around envelope and/or interior finish penetrations such as for pipes, ducts, and

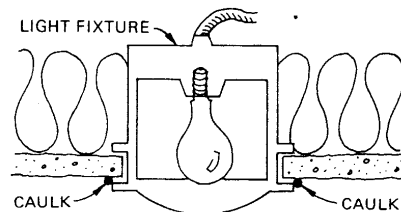
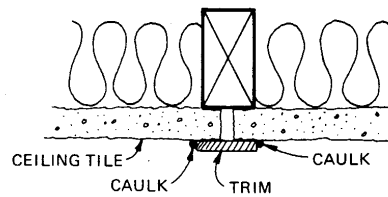
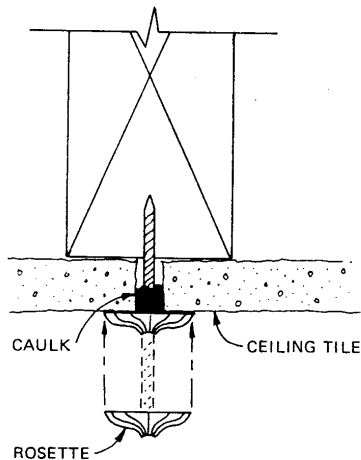
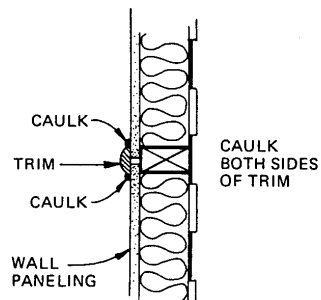
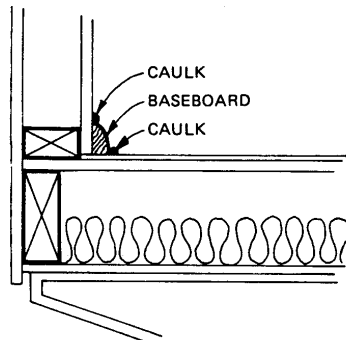
Caulking Compound	Durability	Elasticity	Cost	Comments
Oil-based	1-5 years	Poor	Low	Paintable, should be painted for exterior use
Acrylic latex	2-20 years	Fair-good	Moderate	Easy to apply, water cleanup, paintable, good for most purposes
Butyl rubber	5-10 years	Fair	Moderate	Difficult to apply, solvent cleanup
Polyurethane	20 years	Excellent	Moderate-high	Solvent cleanup, adheres well to most surfaces, unpleasant indoor odor
Silicone	20 years +	Excellent	High	Water cleanup, adheres well to most surfaces, not paintable, good for high expansion/contraction areas, clear color available

Types of Caulk. Latex and silicone will take care of most of your caulking needs. plumbing and electrical fixtures. A thorough job would also include all wall, ceiling, and floor joints and panel joints. The screws and washers ("rosettes") which hold the ceiling panels in place can also be loosened and caulked. As joints and window and door frames are almost always covered with trim, there are two choices

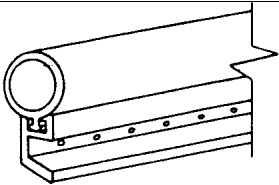
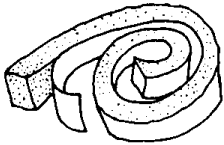
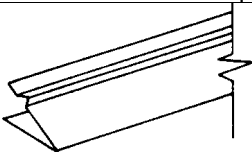
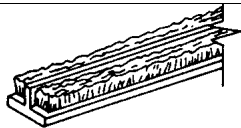
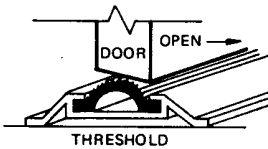
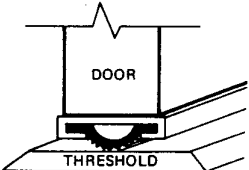
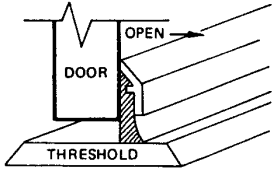
on how to caulk: remove the trim and caulk the gap, or caulk on both sides of the trim. Removing trim is a time-consuming and difficult job, as it can break easily, so it may be better to caulk both sides of the trim. Use either a clear caulk, or one that matches the interior finish. (*Illus. 5 and 6.*)



5. **Where to Caulk.** Caulk around window and door frames, and where water lines and other utilities enter the building. Caulk around plumbing fixtures too.



6. **Where to Caulk.** A thorough job of caulking also includes baseboards, ceiling and wall joists, ceiling fasteners, and electric fixtures.

Weatherstripping		Durability	Comments
Rotted vinyl with rigid metal backing		5 years +	Must make contact for proper seal. Visible when installed. May become brittle with age.
Foam rubber		1-2 years	Easy to apply. Short life span.
Thin spring metal		5 years +	May lose some flexibility with time and therefore lose its sealing ability. Can usually be resprung with a screwdriver.
Fin seal (nylon brush with thin plastic strip down the middle)		5 years +	Used to replace worn weatherstripping on aluminum horizontal sliding windows and sliding glass doors.
Vinyl bulb threshold		5 years +	Usually need to replace threshold. Need to bevel door.
Door shoe		5 years +	Need to trim bottom of door. Need flat threshold.
Door sweep		5 years +	Easy to install. May drag on carpet if door swings in.

Types of Weatherstripping. Use any of a wide variety of weatherstripping types to seal moving joints at windows and doors.

Weatherstripping

Weatherstripping materials include narrow strips of metal, vinyl or foam that provide an air-tight seal between the frames and moving parts of doors, windows and access panels.

Check your home for existing weatherstripping and see if it needs to be replaced. If you can feel a draft coming in around any of your doors and windows, or if

you can see light shining through, weatherstripping is needed.

Several types are available, as shown below.

To install weatherstripping, follow the manufacturer's instructions, as each type has its own method of installation. Here are a few general suggestions:

Doors

- ◆ Manufactured home doors are easily weatherstripped with self-sticking cellular foam strips placed between the door and the door frame surface. These strips compress to form a tight seal when the doors are closed.
- ◆ The bottoms of doors can be weatherstripped by applying a rubber sweep seal on the bottom edge of the door. This can be adjusted to seal against the threshold when closed.
- ◆ Another door bottom seal is available as a rubber bulb set into a threshold. This requires no application to the door, but does require replacement of the threshold.

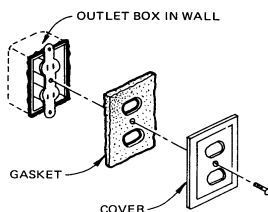
Windows

- ◆ Window weatherstripping can be complicated, depending on the operation of the window. Most manufactured home windows are of the sliding type, with felt or fuzzy strips built into the edges and forming a seal with the aluminum frame. Check these strips—they tend to wear down rapidly and require more permanent replacement.
- ◆ Several weatherstripping kits are available for windows. The best types are those that do not hamper the operation of windows, yet seal tightly when windows are closed.

Insulating Gaskets

Buy some insulating gaskets and install them behind electrical outlet and light switch plates as follows:

1. Turn off the electricity at the circuit breaker.
2. Remove the screws holding the wall outlet or switch plate.
3. Place the insulating gasket behind the plate.
4. Reattach the plate and turn the power back on. (*Illus. 7.*)

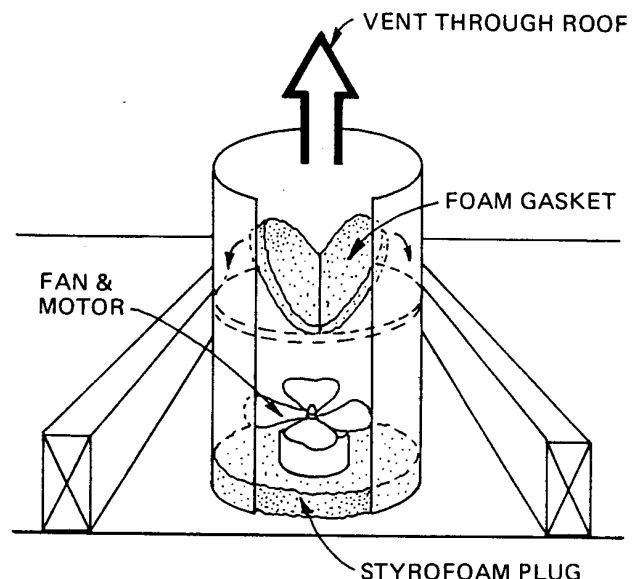


7. **Insulating Gaskets.** These are inexpensive and easy to install, and they significantly reduce air leakage.

Kitchen and Bathroom Vents

Another common source of air leakage is kitchen and bathroom ventilation fan vents. These often are provided with covers to seal the opening when the fan is not in use; usually the cover is not sufficient to prevent air leakage. Caulk around the vent (between the vent and the interior paneling) and weatherstrip the cover. If the cover is missing, one can be made of wood paneling and weatherstripping.

If moisture buildup inside the home is not a problem and the fans are not used during the winter, an insulating "plug" can be made from rigid insulation or foam rubber and inserted into the duct from either end. Make sure it seals tightly. (*Illus. 8.*)



8. **Kitchen and Bath Vents.** Vents should have pop-open gaskets, and the whole unit can be sealed with an insulating "plug" in wintertime.

Indoor Air Quality

There is concern today about indoor air quality and the dangers of making a home "too tight" by caulking, weatherstripping and so on. This applies to manufactured homes in particular because of the relatively small air volume and the amount of synthetic materials which can produce formaldehyde fumes. However, recent research indicates that a great deal of tightening up of manufactured homes is

possible without impacting on safety requirements.

Here are some things you can do to improve your indoor air quality.

- ◆ Control your home's ventilation. Open a few windows momentarily for a cross draft that will clear the air without allowing excessive heat loss.
- ◆ Make sure there is sufficient combustion air for wood-burning heaters, kerosene heaters, etc. This is especially important if your furnace or water heater draws combustion air from the manufactured home interior.
- ◆ Provide additional ventilation if the indoor humidity level is high, especially when doing such moisture-producing things as cooking, showering, and using a clothes dryer vented to the interior.
- ◆ Contact your local health officials if you suspect any health-endangering problems due to the inadequate ventilation of indoor air.

◆ Air-to-air heat exchangers are devices which ventilate your home and reclaim some of the lost heat.

Improving Windows and Doors

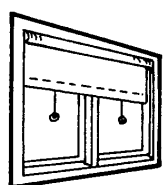
Caulking and weatherstripping will help reduce heat loss *around* windows and doors, but not *through* them. Here are some options for dealing with this major heat loss problem.

Windows

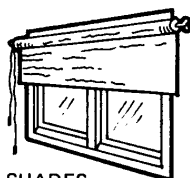
Manufactured homes built to the 1976 HUD standards have storm window panels or insulating (double) glass as standard equipment. But these may need replacement from time to time. And older homes—especially in the colder parts of the state—probably need window improvements. Your options include:

1. *Interior manufactured home storm panels.*

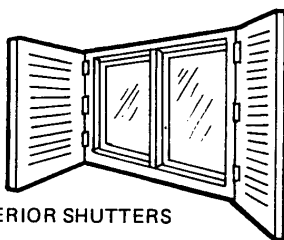
These are made of glass and aluminum extruded frames which you can purchase



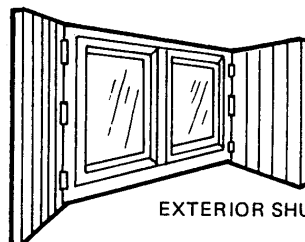
ROLLING SHADES



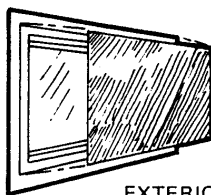
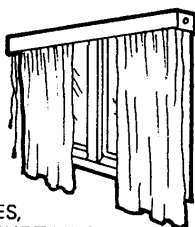
INTERIOR SHUTTERS



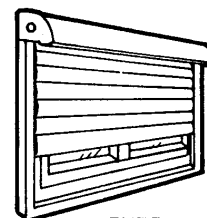
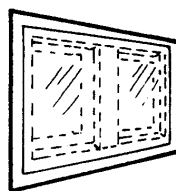
EXTERIOR SHUTTERS



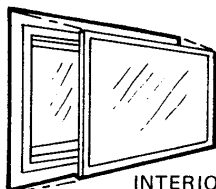
ROMAN SHADES,
DRAPES AND CURTAINS



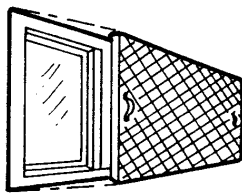
EXTERIOR SUNSCREEN
AND TINTED GLASS



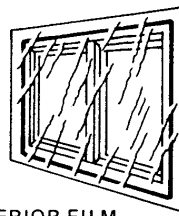
EXTERIOR
ROLL-DOWN
SYSTEM



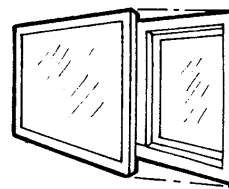
INTERIOR STORM
WINDOW



INTERIOR PANELS



INTERIOR FILM



EXTERIOR STORM
WINDOW

9. Window Treatments. Many options are available. The most important part of any window treatment is that it seal tightly around the window.

ready-made to your window dimensions or in kit form. Less costly (and less permanent) interior storm panels are made of plastic and tape, also available in kit form.

2. *Exterior storm panels.* These tend to be more expensive and more difficult to install than the interior panels. They are subject to weather and need drip caps to carry away water running down the face of the exterior wall panels above the window. However, they can be effective in curbing heat loss, can be attractive, and, in some cases (such as certain older manufactured homes which have cranked windows), are the only type of storm windows that can be installed.
3. *Interior insulating panels.* This is simply a form of insulating material, such as rigid insulation cut to size, which covers the inside of the window and is sealed tightly around the edges. So the panels can be removed easily during the day and replaced easily at night, seal the edges with magnetic strips or Velcro strips. Cover the panels with cloth or other material to improve their appearance.
4. *Curtains.* Curtains can help if they have a valance, but their usefulness is limited because they don't seal around the window. (Illus. 9.)

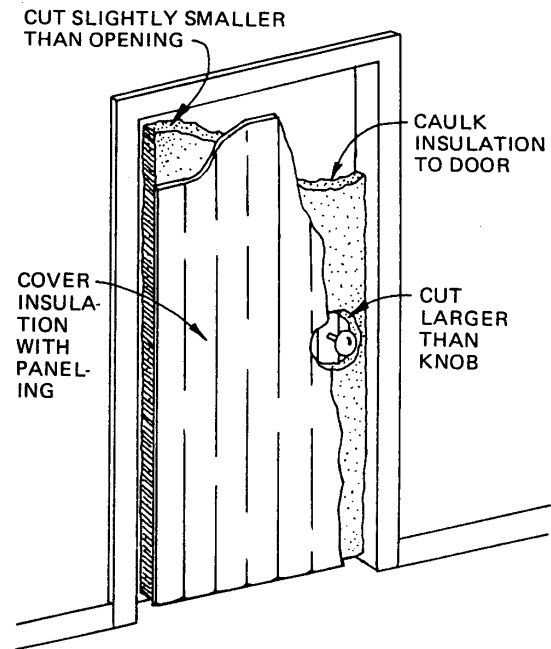
If you add interior storm windows and have condensation problems on the regular window, drill small vent holes in the regular window sash to allow moisture to escape to the outside. This will help prevent moisture penetrating the wall and damaging insulation or structural framing.

Manufactured home windows should be replaced if they do not open and close properly, particularly if they are jalousie (louver-type) windows. Replace them with double-hung or sliding windows.

Do not install a storm window panel over a fire escape window without making sure that anyone living in the home can quickly and easily push it out.

Doors

Storm doors are generally not cost-effective in manufactured homes. Exterior doors can be insulated, however, and this can be worth the expense and effort for the uninsulated doors on pre-1976 manufactured homes. Here's how:



10. **Insulation of Exterior Door.** Exterior doors can be retrofitted with rigid insulation to reduce heat loss through the door. This is particularly important in pre-1976 manufactured homes.

1. Cut rigid insulation (1" polyurethane is fine) slightly smaller than the size of the door.
2. Cut a hole for the door handle with enough clearance so that you can still operate the door.
3. Caulk the insulation to the inside surface of the door.
4. Attach paneling or other finish material over the surface of the insulation and molding around the edges to match your home's interior decor and to reduce any fire hazard from the insulation material. (Illus. 10.)

Replacement of manufactured home doors usually is not cost-effective unless the door is inoperable or does not close properly.

Insulating Your Manufactured Home

If your home was built after 1976 in Missouri or states to the north, you should have enough insulation for most Missouri climate conditions in your floor, walls and ceiling. Older manufactured homes usually are not adequately insulated.

Manufactured home floors and skirting can usually have insulation added without too much expense and difficulty, but re-insulating walls

and ceilings may not be worth the money, effort, and potential structural damage unless you have a pre-1976 home.

Types of Insulation

Insulation works by resisting the flow of heat through materials. The measure of this resistance is called the *R-value*. The higher the R-value, the better the material's resistance to the flow of heat.

Listed below are the most common types of insulation, with information about costs and R-values.

Fiberglass or rock wool blankets or batts are the most common and inexpensive types of insulation. Fiberglass, rock wool, and cellulose also come as loose fill. These materials are usually put between the structural studs or joists of manufactured homes.

The next most common is rigid insulation, usually extruded or expanded polystyrene, polyisocyanurate, or polyurethane. These materials have a better R-value per inch than blankets or batts and can be placed in a cavity or on a surface.

A third type of insulation is in-place foam, such as polyurethane. This material is expensive, but it seals whatever it touches. It also can go in cavities or on surfaces. It is usually applied on exterior surfaces, then coated (for roofs) or stuccoed (for walls).

The best insulation materials can be of no help at all if they are not properly installed, or if they are in poor condition (bunched up, sagging, wet, etc.).

The table below gives some recommended levels of insulation for manufactured homes in Missouri—you might want to insulate more in the colder parts of the state and less in the warmer parts.

A rule of thumb is that if you are going to the trouble and expense of adding insulation, add enough to make it highly energy-efficient.

Location	Minimum Recommended	Highly Energy-Efficient
Ceiling	R-30 (9 1/2" batt)	R-38 (12 1/2" batt)
Walls	R-19 (5 1/2" batt)	R-19 (5 1/2" batt)
Floor	R-19 (5 1/2" batt)	R-22 (7 1/2" batt)

Insulation levels. These are average recommended values for manufactured homes in Missouri

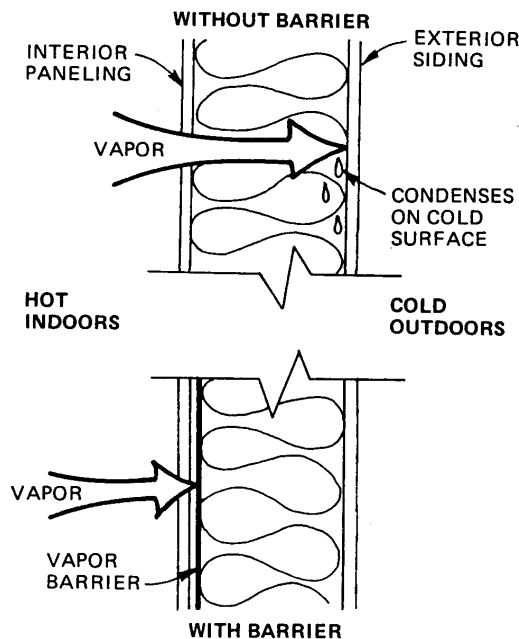
	Insulation Type	R-Value (approx.)	Relative Costs (1986 approx.) (per R per sq. ft.)	Comments
Batt	fiberglass or rock wool	3 1/2" (R-11) 5 1/2" (R-19) 9 1/2" (R-30)	1.5 to 1.7 cents	Inexpensive. Need cavity to place in. Can compact. Must be installed properly. Moisture and compaction will reduce R-value.
Loose Fill	fiberglass or rock wool	R-3 per inch	1.5 to 1.7 cents	Inexpensive. Need cavity to place in. Can settle and compact. Moisture will reduce R-value. Usually blown in with equipment.
	cellulose	R-3 + per inch	1.5 to 1.7 cents	Inexpensive. Need cavity to place in. Can settle and compact. Will not tolerate moisture. Usually blown in with equipment. Contains fire retardant.
Rigid	expanded polystyrene (beadboard)	R-4 per inch	3.0 to 4.0 cents	Least expensive rigid insulation. No cavity needed. Combustible. Absorbs moisture, degrades in sunlight.

Foam	extruded polystyrene	R-5 per inch	4.0 to 5.0 cents	Most moisture resistant. Good for in-ground use. No cavity needed. Combustible. Degrades in sunlight.
	polyurethane or polyisocyanurate	R-7 to R-8 per inch	4.0 to 5.0 cents	Very high R-value per inch. No cavity needed. Combustible. Degrades in sunlight.
	polyurethane	R-7 to R-8 per inch	7.0 to 10.0 cents	Requires equipment to foam in place. Mix must be correct. Very expensive. Seals well and results in rounded appearance. Combustible.

Insulation Types. Use the appropriate material for the job and make sure it is installed properly.

Vapor Barriers

If your home is well-sealed thanks to good construction, caulking, weatherstripping, storm windows, and insulation, the humidity level will increase. If this moisture is allowed to penetrate the interior surface of the insulation cavities, over a period of time it may reduce the effectiveness of insulation and damage other building materials. (*Illus. 11.*)



11. Vapor Barrier. If a vapor barrier is not used, condensed moisture can reduce effectiveness of insulation and damage structural members.

A vapor barrier will help prevent this. To be effective, a vapor barrier must have a high resistance to the flow of moisture and must be

installed on the heated (interior-facing) side of the insulation. The lower the "perm-rating" of a

vapor barrier material, the better its resistance to moisture penetration.

Vapor barrier materials include polyethylene plastic, low-perm-rated paints, vinyl wall coverings, and foil-type wallpapers.

Polyethylene vapor barriers are usually installed under the interior finish at the time of manufacture. Check to see if there is one by carefully removing a piece of interior molding around a window or door and looking under the edge of the wall paneling. In many cases, the only practical way to add a vapor barrier to an existing wall or ceiling is to use a low perm-rated paint (with a perm-rating of one or less).

Batt or blanket insulation is available with attached foil or kraft-faced vapor barriers.

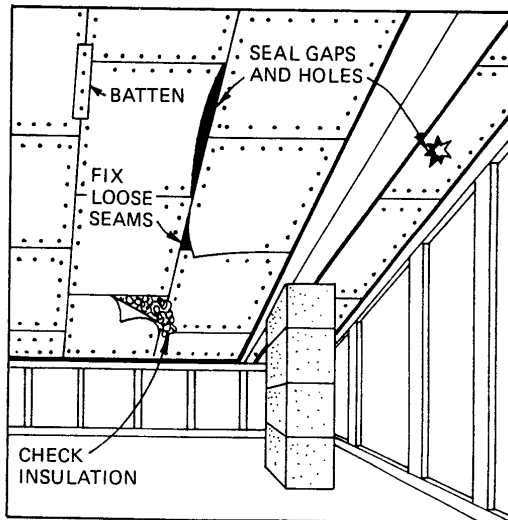
Floor Insulation

If you have installed insulated, seasonally-vented skirting (see the following section), you may not need to insulate your floor. But, in general, if you have an older manufactured home (whether skirted or not), and if you can gain access to the floor beneath the home, insulation is worth considering. Here are some guidelines:

- ◆ The insulation should be in the R-11 to R-19 range (3 1/2"-5 1/2" batts).
- ◆ The floor should be sound, with no water leakage problems.
- ◆ The belly board should be in good repair. (The belly board is designed to prevent air infiltration through the floor and to protect the insulation, wiring, and floor support members from damage during moving and

after the unit is placed on piers.) In some newer units, the belly board has been replaced by a fabric air-infiltration barrier. (*Illus. 12.*)

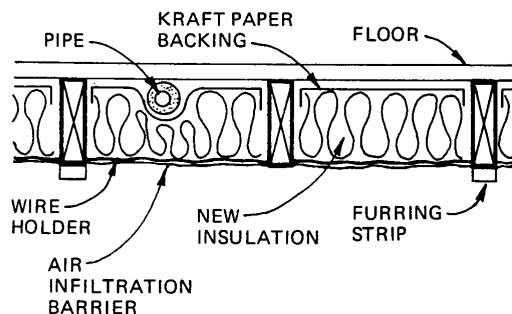
- ◆ If you encounter the heating duct, insulate it if exposed and check duct joints for gaps (see the section "Heating Your Manufactured Home").



12. **Belly Board.** Keep the belly board in good repair to protect materials above it and reduce air infiltration through the floor.

Here are your major floor insulation options:

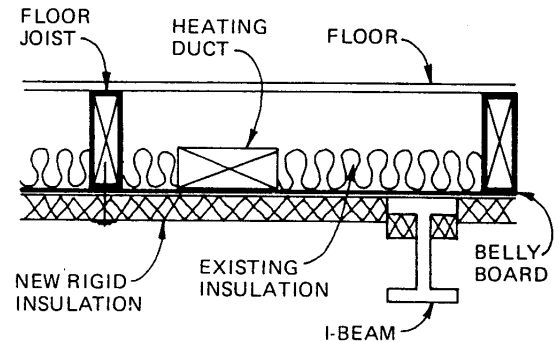
1. *Re-insulate existing floor cavity.* Remove belly board and add batt insulation between floor joists. If there is no existing insulation, or if the existing insulation needs to be replaced, place vapor barrier *up*. If the existing insulation is OK, place the vapor barrier *down* and slash it with a knife to allow moisture to escape. Use wire to hold the insulation in place. Replace the belly board or install new air infiltration barrier—not a vapor barrier. (*Illus. 13.*)



13. **Reinsulation of Floor Cavity.** This method is best if there is no existing floor insulation, or if it needs to be replaced.

2. *Insulate under the belly board.*

Attach exterior-grade rigid insulation directly underneath the belly board. Secure fasteners through the insulation and into the floor joists so the belly board does not have to support the



added weight. (*Illus. 14.*)

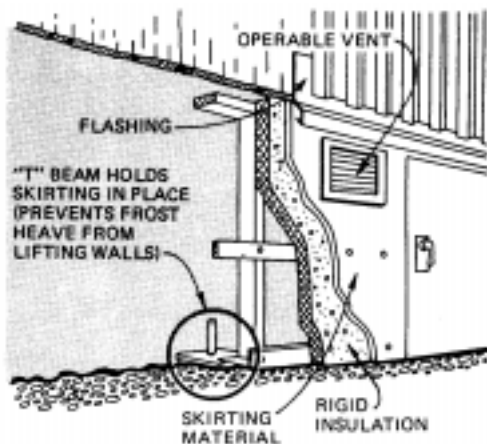
14. **Addition of Rigid Floor Insulation.** This is one way to supplement the existing floor insulation.

Manufactured home floors also can be insulated with loose fill insulation (by drilling holes in the band-joist of the floor and blowing insulation over the top of the existing insulation or blowing insulation into a "sack" under the belly board), but these methods are usually more difficult than the options listed above.

Skirting

Skirting, which encloses the space between the manufactured home and the ground, can enhance the appearance of your manufactured home, serve as a windbreak, help reduce the chances of frozen pipes in winter, and help reduce floor heat loss. Uninsulated, ventilated skirting may have little effect on energy conservation, but insulated skirting with operable vents (closed in winter, open in summer to prevent moisture buildup) can be an effective, although relatively costly, conservation measure. Installing insulated skirting should be done when the floor cannot be adequately insulated or when skirting is being installed for other reasons. (*Illus. 15.*)

Before adding skirting, the home should be properly anchored, leveled, and blocked. The materials used for skirting are the sheathing (or covering) and the framing to which the sheathing is attached. Sheathing materials range from fiberboard to plywood to steel, aluminum, or polyethylene panels; the most common is

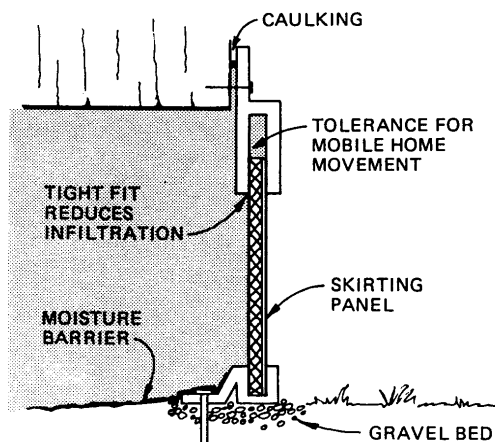


embossed aluminum which matches the siding. Whatever framing materials you choose—wood, steel, or aluminum—make sure they are fireproof, moisture-proof, and installed according to local codes.

15. Framed Skirting. The best skirting system is well-sealed and well-insulated and has operable vents which are closed in winter and open in summer to reduce moisture build-up under the home.

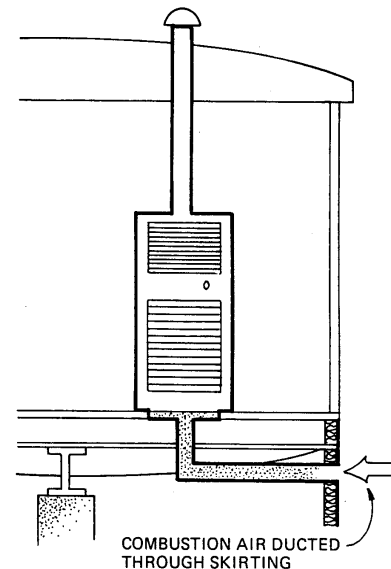
Here are some pointers about skirting:

- ◆ The skirting should seal against the ground and against the edge of the manufactured home, but also should have some play—some ability to move slightly up and down, especially in areas where there is danger of severe frost heaving. One way to allow for this is to provide a slip joint where the sheathing is attached to the home. Make sure the slip joint also seals well. (*Illus. 16.*)



16. Skirting With Slip Joint. Where frost heaving is a problem, the skirting should be able to move up and down slightly, yet provide a tight seal against air infiltration.

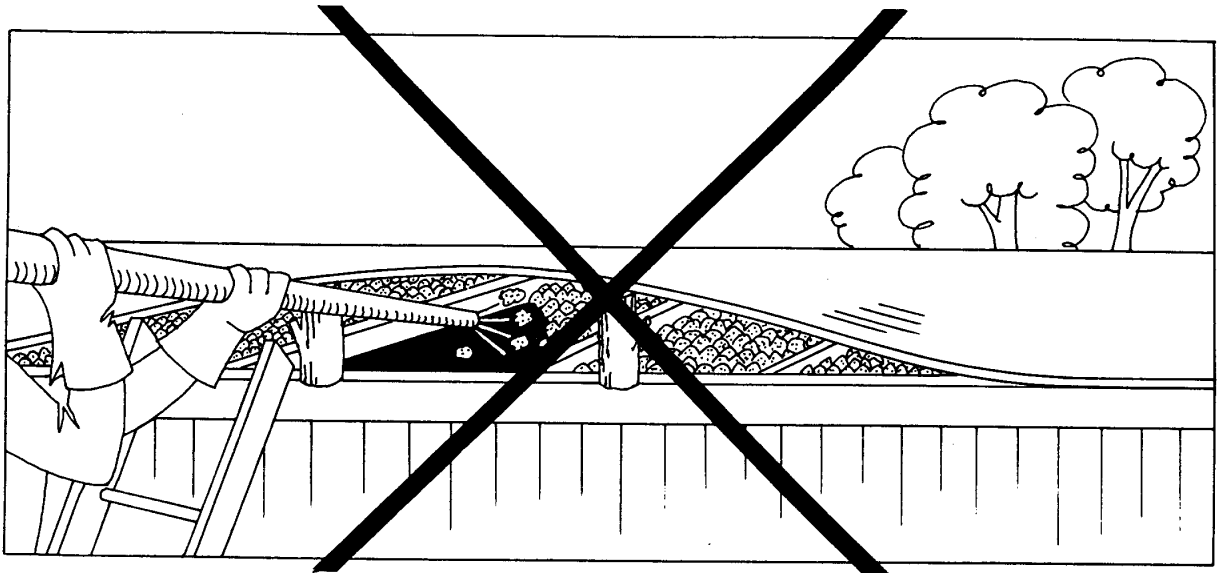
- ◆ If moisture buildup is a problem, place a vapor barrier covering the ground under your manufactured home. Use 6-mil polyethylene plastic sheeting or 15- or 30-lb. asphalt rolled roofing material, with seams overlapped 12 inches and the entire cover weighted down.
- ◆ If no ground vapor barrier is used, make sure the crawl space under your home is adequately ventilated during the warm part of the year.
- ◆ In some manufactured homes, fresh air for the combustion of gas furnaces and water heaters is drawn from underneath the home. If you are installing a well-sealed skirt, be sure to duct the combustion air in from outside the skirt to the furnace and/or water



heater. (*Illus. 17.*)

17. Combustion Air Duct. *Important*—If the furnace or water heater draws combustion air from beneath the home, and the skirting is not ventilated, air must be ducted to these appliances. Newer manufactured homes draw combustion air through a sleeve around the exhaust flue.

- ◆ Make sure to comply with all local code requirements before doing any work with skirting, vents, or ducts. Once you have met all the code requirements, proceed with insulating the skirt, using batts or blankets or rigid board insulation—all in the R-11 to R-19 range.



18. **Re-insulation of Walls and Ceilings.** These are difficult projects and require an expert to avoid major structural damage. One way to reinsulate a ceiling is to prop up the roof and blow in loose fill. **DON'T DO THIS YOURSELF!**

Ceiling and Wall Insulation

Insulating manufactured home ceilings and walls can be extremely difficult and, unless you are an expert, can result in structural problems—bulging, poor fitting of reinstalled siding or roof panels, etc. Insulating ceilings and walls is generally advisable only when you are doing other work that requires removing siding or roof panels.

The three basic insulating methods are (1) blowing loose fill insulation into the existing roof and wall cavities; (2) removing the siding and the roof panels, adding insulation to the existing cavities, then reattaching the siding and panels; or (3) installing insulation and new exterior finish directly over the old exterior and constructing a new roof.

If you decide to insulate your ceilings and walls, make sure your manufactured home can bear the additional weight or be supported to bear the weight. In any event, if you haven't done this type of work before, get the advice of a manufactured home dealer, building materials supplier, or building contractor who has experience in manufactured home insulation.

Heating Your Manufactured Home

Your heating system probably accounts for about 55 percent of your overall energy cost, so

you need to keep it operating as efficiently as possible.

Furnace Size

Most manufactured home furnaces are oversized for the job they need to do, especially in a well-sealed and well-insulated home. Here's how to test for oversized gas or oil furnaces.

1. On a winter night that is very cold for your area, set the thermostat at 70°F.
2. Wait a while for the home to settle down at 70°F, then sit by the furnace and pay close attention to the burner (not the fan). Time the total number of minutes the burner is lit during a one-hour period.
3. The burner should stay lit for a total of at least 40 minutes during the hour. If it stays lit for much less than 40 minutes, the furnace is oversized. A serviceman can make the needed adjustments, such as changing the burner orifice.

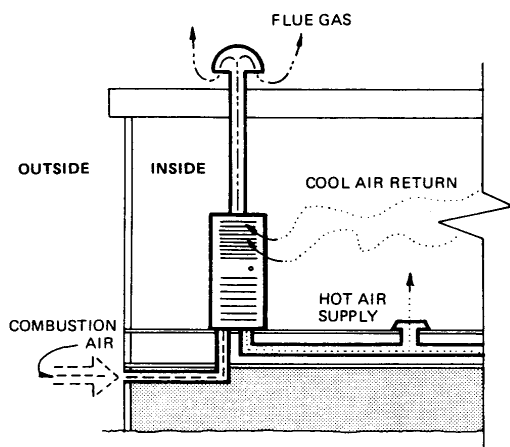
Combustion Air

About 60 percent of the manufactured homes in Missouri have gas (natural gas or propane) forced-air heating systems. This type of system produces heat by burning a mixture of gas and air in the combustion chamber of the furnace.

It is important to make sure you have enough combustion air for your furnace to operate efficiently and safely. In most older manufactured homes, this air is drawn from beneath the home. If the home is skirted, there should be enough ventilation through ducts or vents in the skirting to allow adequate air for complete combustion of the furnace and thus to prevent any buildup of dangerous carbon monoxide.

Many newer manufactured homes have furnaces with sealed combustion units. These units have a venting system using two vents in one pipe which extends through the ceiling—a pipe within a pipe. The exterior pipe brings in fresh outdoor air for combustion. The inner pipe (or flue) is the exhaust pipe for the products of combustion (carbon dioxide, water vapor, etc.) to escape to the outdoors. Make sure both pipes are properly connected.

If you have any doubts about the adequacy or safety of your heating system's combustion air supply (or the combustion air supply for such other gas appliances as water heaters), have it checked by a qualified professional. (*Illus. 19.*)



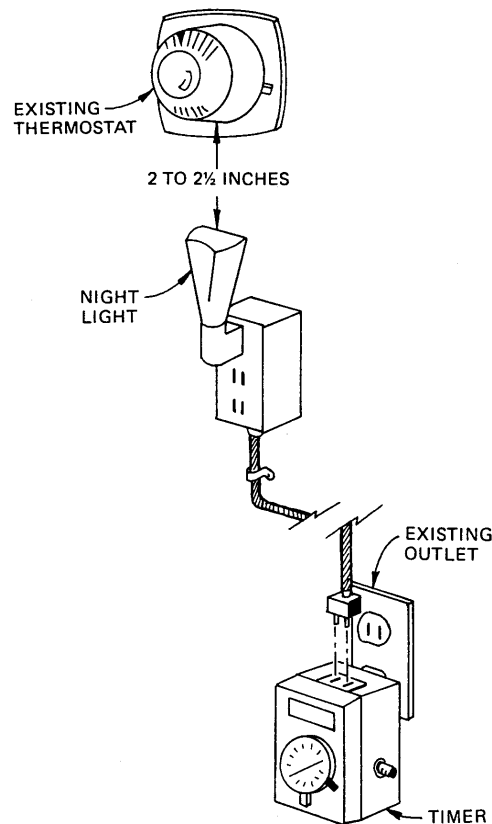
19. **Furnace Operation.** There are two distinct air flows in the operation of a gas-fired, forced-air furnace: (1)

combustion air intake and flue gas exhaust and (2) the heating air supply and return.

Thermostats

Automatic setback thermostats reduce the temperature setpoint at night and cause the furnace to burn less fuel. These are a good idea if you are not in the habit of adjusting your thermostat at night, but they are expensive—about \$30-\$90. A simple device which costs about \$10 can be used to trick your thermostat instead. Install a night-light on a timer a few inches below the thermostat. This effectively lowers the setpoint during the hours the nightlight is on. (*Illus. 20.*)

Sometimes thermostats are improperly located—for example on an outside wall or near windows or exterior doors. This causes the furnace to come on more frequently and waste heat. In extreme situations, the thermostat should be relocated to an interior wall away from exterior windows and doors, particularly doors. It is best to have a qualified serviceman do the job.

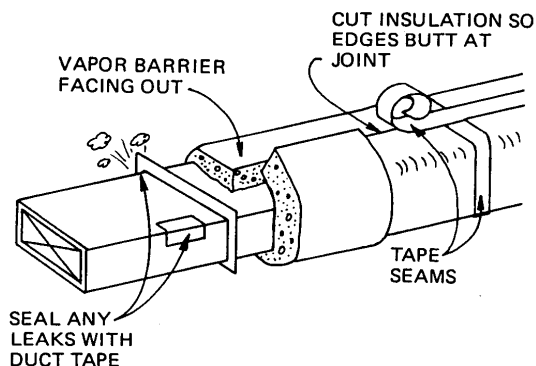


20. **Do-It-Yourself Clock Thermostat.** This is an inexpensive way to automatically set back your thermostat at night. Adjust the height of the night light until you get the right amount of setback.

Ducts

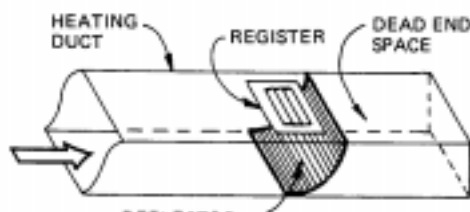
Single-wide manufactured homes have one long heating duct extending the length of the home, while double-wides have two long ducts plus a crossover duct. Make sure the crossover duct is properly connected and is strapped up off the ground. If not, attach 1" perforated steel banding to hold it in place, making sure there are no kinks in the ducts which would restrict the free flow of air.

If your home's ducts are exposed and easy to get to, check for air leaks and insulate them. Repair leaks with duct tape. To insulate, wrap batt insulation (with the vapor barrier facing outward) around the ducts, and seal insulation joints with duct tape. (*Illus. 21.*)



21. **Heating Duct Repair.** If the duct is exposed, seal any leaks and insulate it well.

In some older manufactured homes, there are "dead ends" beyond the last register at each end of the manufactured home's heating duct. To prevent heat from being wasted here, a sheet-metal scoop can be placed just past the last register to direct the heated air through the register. Check this situation by removing the register and inspecting with a flashlight and



mirror. (*Illus. 22.*)

22. **Heating Duct Scoop.** To eliminate wasted heat at duct dead-ends, put in deflectors before the dead-ends to direct the supply air through the registers.

Heating System Maintenance

You can do much of the maintenance on your heating system yourself, but call on a professional if you are unsure about it. Before doing any work on your furnace, turn off the electric power to the unit—and follow the manufacturer's instructions.

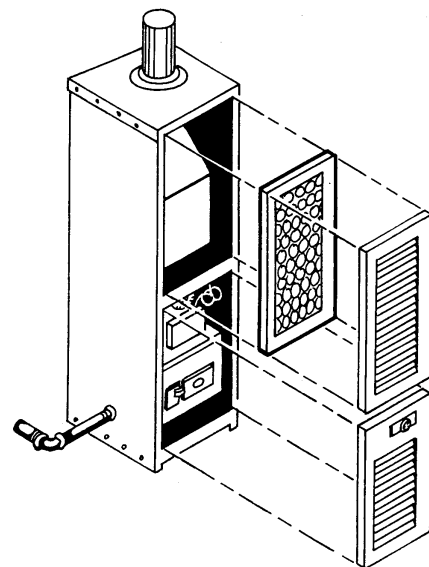
Here are some basic energy-saving maintenance procedures:

Pilot

- ◆ Turn off furnace pilot light in the summer.

Filters

- ◆ Check your furnace filter (or filters) monthly during the heating season and clean if necessary.
- ◆ Replace filters yearly. (*Illus. 23.*)



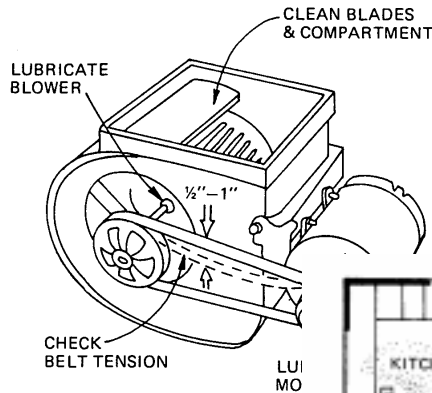
23. **Furnace Filter.** Check your filter monthly and replace it annually. The filter is located between the return air grille and the furnace blower.

Blower

- ◆ Clean the blower blades and blower compartment at least once a year.
- ◆ Lubricate the blower and blower motor at least once a year or according to manufacturer's instructions. (This is not

necessary if your blower and motor have sealed bearings.)

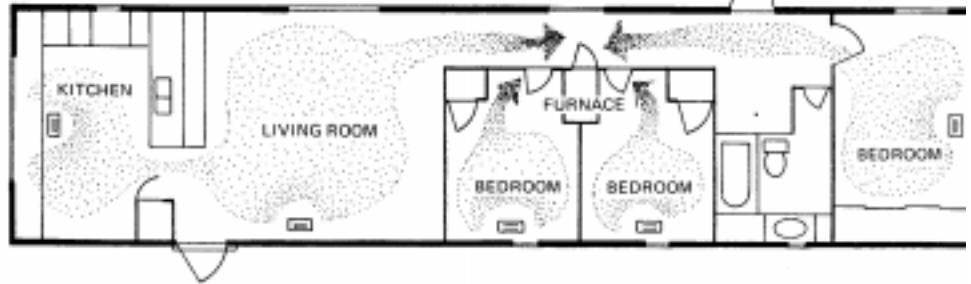
- ◆ Check the blower belt for wear and tension. Replace if necessary, or adjust only enough to keep the belt from slipping. (*Illus. 24.*)



Woodburning

Portable Heaters

Before purchasing a portable heater for your manufactured home (such as an electric heater, a radiant quartz electric heater, or a kerosene heater), make sure its use in a manufactured home is both safe and legal (check with your local building officials when in doubt). Electric heaters can be used safely for intermittent periods of time if you wiring is in good shape and of adequate



24. **Furnace Blower.** Service the blower once a year. If the blower and blower motor have sealed bearings, lubrication is unnecessary.

Registers

- ◆ Keep all heating registers clean and free of dust. Make sure they aren't covered with carpeting or otherwise blocked, and that they can be freely opened and closed so you can regulate (to some extent) the heat coming into each room.

Return Air

- ◆ Make sure that return air is not impeded. Check the grille on the furnace closet door. Interior doors are cut short so return air can move back to the furnace. (*Illus. 25.*)

Stoves and Fireplaces

Think hard about installing a wood stove in your manufactured home. They tend to overheat the room they are in, can cause indoor air pollution and are a fire hazard.

If you decide to purchase a wood burning stove for your manufactured home, make sure it is approved by your local building officials, then install it in accordance with the manufacturer's specifications.

Both woodburning stoves and fireplaces should have the combustion air ducted into the firebox from outside the manufactured home. If not, there must be proper ventilation to reduce the problems of oxygen depletion and pollution of the air inside the home. In the case of a fireplace, always close the damper after the fire is dead out and keep it closed when the fireplace is not in use to prevent your warm inside air from escaping. Keep in mind that fireplaces are typically very inefficient.

25. **Return Air Pathways.** The warm air supplied by the furnace to floor registers in each room must be able to return to the furnace's air grille.

Water Heating

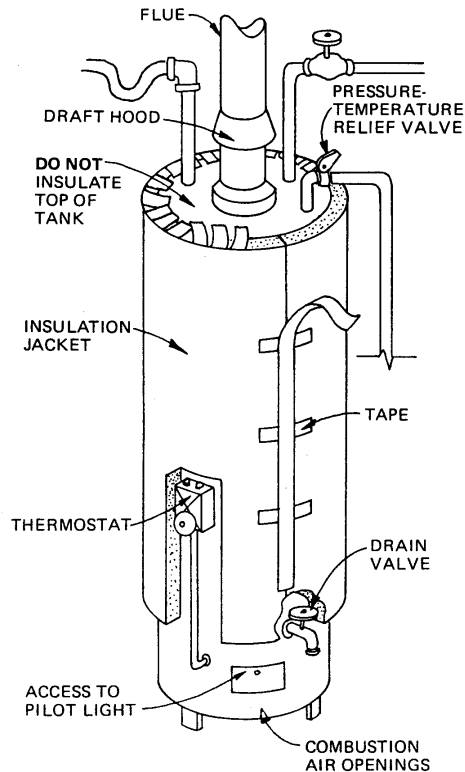
Next to your furnace, your water heater probably uses more energy than any other appliance in your home. Here are some ways

you can operate it more efficiently, and some safety tips:

- ◆ Repair any leaks in your faucets and hot water pipes. One drip per second from a

faucet can waste 200 gallons of water a month.

- ◆ Install low-flow showerheads (these generally work better than showerhead flow restrictors).
- ◆ Use cold or warm water to wash clothes; rinse with cold.



26. **Gas Water Heater.** Here are the points that should not be covered. Particularly important are the combustion air inlets, the draft hood, and the flue. Recommended: Install upside down "P" or "S" trap on outgoing hot water pipe.

- ◆ Turn down the water heater thermostat to the lowest acceptable level (somewhere around 120°F), keeping in mind that dishwashers often require higher temperatures—check the dishwasher manufacturer's instructions.
- ◆ Insulate the water heater tank and exposed pipes.
- ◆ Drain sediment from the bottom of the tank periodically. To do this, drain about a bucketful of water from the drain valve at the bottom of the tank about once a month—but do this only if your water heater is less than one year old or if it has been drained on

a regular basis. Water heaters that have not been drained regularly may have drain valves that become clogged and will not close once opened. *If the drain valve does not open easily, do not force it.*

- ◆ With gas water heaters, make sure the combustion air supply and exhaust flue are not blocked. If air is drawn from inside the manufactured home, consider ducting it in from outside.
- ◆ With electric water heaters, turn off the electricity to the heater before you do any work or make any adjustments, including adjusting the thermostat.

Adjusting the Water Heater Thermostat

Gas Water Heaters

To adjust the temperature, turn the thermostat dial to the desired setting. ("Warm" is usually about 120°F; and "Normal" is usually about 140°F.) Some heaters have a cover over the dial; this can be easily removed by lifting in and out.

Electric Water Heaters

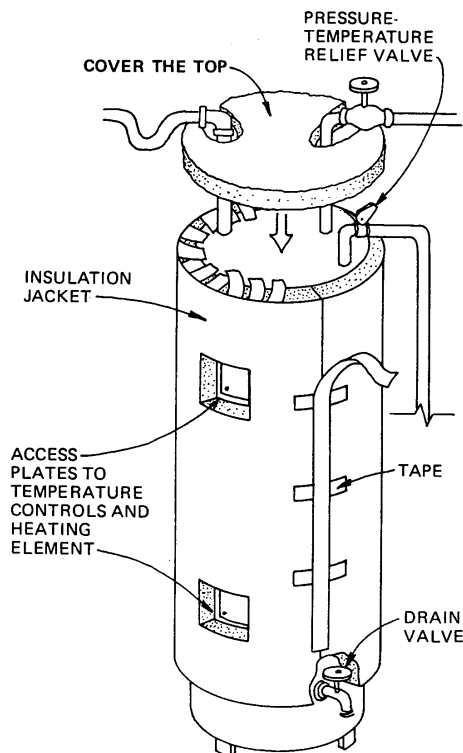
1. Turn off the electricity to the heater.
2. At the front of most electric water heaters there are one or two panels that cover the temperature controls. Unscrew and remove these panels.
3. Carefully part the insulation so you can see the temperature dial (or dials—there may be two).
4. Using a screwdriver, turn the indicator to the desired setting. If there are two controls (one behind the top panel and one behind the bottom panel), turn the indicator to the same setting on each, or set the top control slightly lower than the bottom control.
5. Carefully replace the insulation as you originally found it, then screw the panels back on and turn on the electricity.

Insulation

Some of the newer water heaters are manufactured as energy-saving models with adequate built-in insulation. Other heaters may need some extra insulation around the tank to reduce heat loss.

You can buy and install a ready-made water heater insulation blanket kit, or you can make

your own wrap-around blanket from part of a roll of 3 1/2" (R-11) or 5 1/2" (R-19) fiberglass insulation. When you wrap the tank, be sure to tape all seams. If using a homemade insulation wrapper, wrap some wire around the insulation to hold it together, but be sure not to compress it too tightly. With a gas heater, be sure not to obstruct the combustion air supply or flue, and do not store flammable materials near the burner or flue. (*Illus. 26 and 27.*)



27. Electric Water Heater. Here are the points that should not be covered. Be sure to turn off the power to the unit when accessing the temperature controls. Recommended: Install upside-down "P" or "S" trap on outgoing hot water pipe.

You can also insulate all exposed water pipes, to protect the water inlet from freezing and to reduce heat loss to some extent. Pipe insulation is usually found in wrap-around insulation kits, flexible tubing, or rigid foam type. Choose a size that fits your pipes snugly. If you live in a colder part of the state and

decide to use heat tape for added freeze protection, be careful not to overlap the tape—and follow the manufacturer's instructions to minimize any fire hazards. It is best to use a heat tape that is thermostatically controlled, rather than one that is on all the time.

Cooling Your Manufactured Home

If you have weatherized your manufactured home with caulking, weatherstripping, and so on, you have taken an important step toward reducing your summertime cooling costs. Effective landscaping can also help—well-placed trees that provide shade (as well as a natural evaporative cooling effect), particularly on the west side of your home, but that don't get in the way of the winter sunshine.

Low-Cost Cooling Options

In addition to natural sunshine barriers, you can install shading devices both inside and outside your home (outside is more effective). For the exterior, consider awnings, shutters, bamboo slat shades, overhangs, and trellises. Large window areas can be shaded on the exterior with greenhouse cloth (available from greenhouse suppliers) that can be removed in winter. For the interior, use white-lined drapes or insulation panels (also used on winter nights). Open the drapes and windows at night during the summer to allow cross-ventilation, close the drapes during the day. Whether or not you leave the windows open during the day depends on your home's cooling system.

Air Conditioning

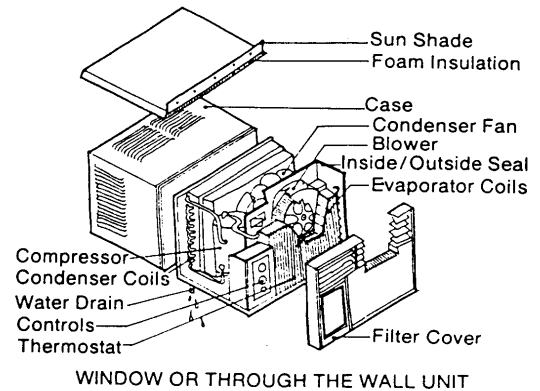
Sun beating down on your air conditioner makes it work harder and costs you money. Locate your window unit or outside compressor on the north, if possible, or you can construct an inexpensive awning to shade it from the afternoon sun.

At the end of summer, remove your window air conditioner or tape plastic over the unit on the *inside* to stop drafts, and cover the outside to protect it from the weather. Central air conditioner compressors do not need to be covered.

Use your air conditioner only when necessary, and keep the thermostat setting as high as you can tolerate. Use a floor fan to move the air. You will feel cooler even with the high temperature. Clean the compressor (the outside unit) once a month, taking care that it is free of leaves, grass and dirt. When mowing, avoid discharging grass toward the compressor. Check your filter each month and change it as needed. Have a maintenance person check your air conditioner every year or two to make sure it is running smoothly. *Keep windows and doors closed when the air conditioner is on!*

You want your house to be as tight as you keep it for winter, so check that storm windows are shut, insulation levels are adequate, and so on.

The above also applies to the outside unit of a heat pump.



Additions to Manufactured Homes

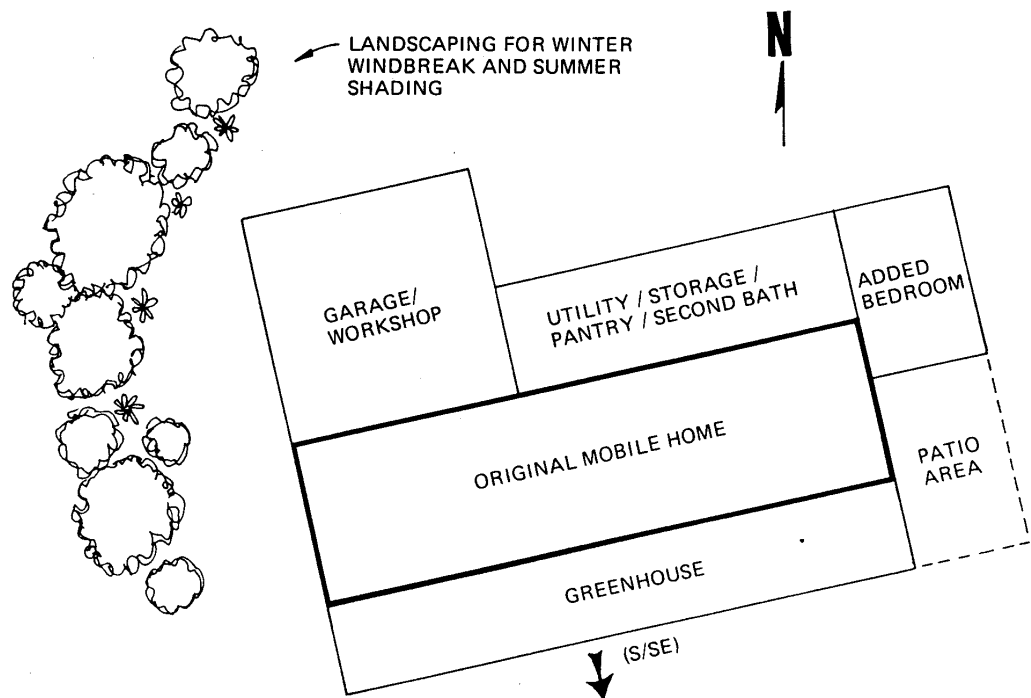
Once installed, most manufactured homes are never moved and become fixed dwellings. Because of this, it is common for manufactured home owners to build such additions as entryways, carports, ramadas, extra bedrooms, utility or work rooms, storage rooms, and so on.

The original manufactured home then provides a service core of plumbing, electrical, and mechanical systems. Extension of these systems to connecting additions is far less expensive than building detached structures with separate service systems.

No manufactured home addition is recommended solely as an energy-saving measure, but if you are planning an add-on project, make energy conservation part of your plan. Additions which connect to the manufactured home provide, at the very least, a buffer between the manufactured home and the weather. If an add-on is well-insulated and has good solar access, it can heat itself and also provide a net heat gain to the manufactured home. (*Illus. 29.*)

Here are some points to consider as you plan your additions:

- ◆ A vestibule, or air-lock entryway, is one of the most practical additions you can make to your manufactured home, since it can prevent the heated or cooled air you have paid for from being let out as people come and go, provide a buffer zone, and provide additional space. The entryway door should be far enough away from the manufactured home door so people do not open them both at the same time. It is not necessary to insulate a vestibule/air-lock entryway, but it will help and it doesn't cost much.
- ◆ If your main entrance (the one you use most often) faces anywhere from southeast to southwest, consider making the entryway into a solar greenhouse or sunspace. You can do this for little or no extra cost, and you will be getting some free solar heat (see next section on solar energy).



29. **Manufactured Home Additions.** Well-designed and well-placed additions can result in an energy-efficient site-built home. The greenhouse and garage can be used as air-lock entryways.

- ◆ Place an unheated space, such as a garage or storage room, on the north side of the mobile home, where it will provide a buffer zone to the coldest weather and not block access to sunlight on the south.
- ◆ Extra bathrooms can tolerate slightly lower temperatures (they can be heated up quickly with a small heater when in use) and can be placed between the unheated areas and the active areas of the home, or off to the east or west.
- ◆ Outside patio areas should be placed toward the east, where they will be warmer on winter mornings and cooler on summer afternoons.
- ◆ A number of manufactured home owners in Missouri have built additions to their homes, then insulated the remaining exposed portions and sided the entire home, giving the home the appearance of a more conventional site-built home and providing a continuous insulated envelope.

Solar Energy for Manufactured Homes

Solar energy can be used in manufactured homes to provide year-round water heating and wintertime space heating. Here are a few solar basics:

- ◆ All solar systems have three components: the *collection* of heat, the *storage* of heat, and the *distribution* of heat throughout the home. Without storage, a solar system can provide daytime heating only.
- ◆ *Passive* solar systems use the building itself for the three components; for *active* solar systems, the components are parts of the installed system.
- ◆ Manufactured homes have two problems when it comes to solar energy: (1) the structure provides little or no thermal mass for the nighttime storage of heat for passive solar systems, and (2) they may not provide adequate space or structural strength for an active solar installation.
- ◆ Most solar measures are expensive with long payback periods. This is not true, however, for passive solar new construction, which involves little or no more cost than conventional construction.
- ◆ Other than incorporating passive solar features at the time of new construction, solar water heating is the most cost-effective measure, because the equipment is utilized throughout the year rather than only during the heating season.
- ◆ Before adding solar to your manufactured home, take all the weatherizing and energy-saving steps you can. Adding solar heating to a leaky home is like pouring water into a bucket with holes in it.

There are three general solar options: daytime heating systems, day- and nighttime heating systems with storage, and water heating.

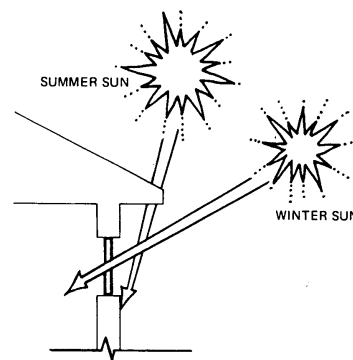
Daytime Heating

Daytime heating with solar energy is easily achievable and particularly appropriate for buildings which have little thermal mass, such as manufactured homes. *Windows* are an ideal daytime heating source (and probably the

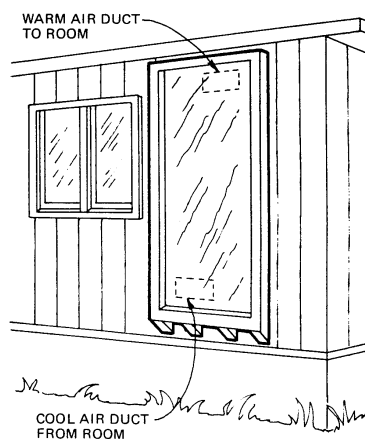
cheapest source, too). Let the sun warm your home through south-facing windows during the day, then close the drapes or insulate the windows at night. (*Illus. 30.*)

A *thermosiphon air panel* (TAP) can be mounted on the south wall (*Illus. 31.*)

Roof-mount air collectors are gaining in popularity. They are ducted directly to and from the room below. These units contain a thermostatically-controlled blower. Make sure your structure can handle the added weight and wind loads.



30. **Windows.** Windows are ideal solar collectors, and a small overhang will reduce summer heat gain.



31. **Thermosiphon Air Panel.** A TAP can be made easily and cheaply, and it will automatically supply heated air to the adjacent room during sunny days.

Day- and Nighttime Heating Systems with Storage

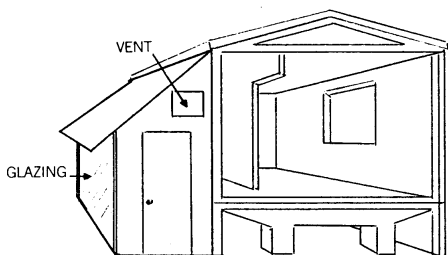
Greenhouse/sunspaces have been popular in Missouri for years because they are relatively inexpensive and are highly effective, and they provide:

- ◆ Added space at relatively low cost.
- ◆ High solar gain.
- ◆ Ease of including added thermal mass for heat storage.
- ◆ Ease of construction, normally requiring limited skills.

A greenhouse/sunspace can be combined with (or used as) an air-lock entryway to reduce heat loss. The thermal mass in the greenhouse/sunspace can be any heavy material, such as rocks, concrete, water-filled drums (use rust inhibitor if metal), etc., which can also be used as a base for planters.

Excess heat from the greenhouse/sunspace can be let into the manufactured home through doors and windows, with or without a fan, or ducted to other rooms in the home. A return air path is necessary.

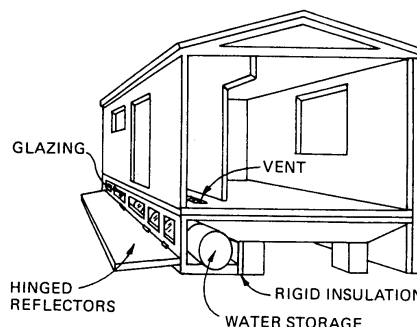
A greenhouse with glazed (glass or plastic) sides and roof tends to overheat in summer. A sunspace with insulated walls and roof and glazed south facade makes more sense in Missouri. Ventilate at top of end walls. Provide overhang for shade in summer.



32. **Greenhouse/Sunspace.** These are relatively easy to build at reasonable cost, provide high solar gain, and add living space.

A passive solar *underskirt* system replaces the manufactured home skirt on the south side with glazing. Hinged panels which provide a daytime reflector and nighttime insulation can be added over the glazing. This system does not provide additional usable space and does not have a large collector area like a greenhouse/sunspace, but can help heat your home at little cost.

Place drums filled with water (and rust



inhibitor if metal) in the space under the manufactured home. Provide vents into the home to let the heat in through the floor. Contact MO DNR/DE for design information. (*Illus. 33.*)

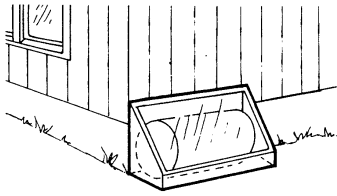
33. **Underskirt Solar System.** This is cheaper than a greenhouse but does not provide as much heat or additional living space.

Water Heating

A solar water preheater is simply a tank between the cold water supply and the conventional waterheater. It can be placed in a greenhouse/sunspace or in an insulated box with a glazed cover. Anything you can do to increase the typical average 65°F cold water inlet temperature will help.

Building a solar water preheater can be a good do-it-yourself project—it can be done cheaply with free discarded conventional water heater tanks. Call Mo DNR/ DE for design information. (*Illus. 34.*)

A complete commercial solar water heating system can be expensive, although in the long run many are cost-effective, particularly if you currently use electricity to heat water. There are many different designs and manufacturers—check your telephone book.



34. **Solar Water Preheater.** This is an easy, low-cost project which can greatly increase the typical 65°F cold water supply temperature.

Sources of Information and Assistance

A wide range of information materials and/or technical assistance is available from:

- ◆ Missouri Department of Natural Resources, Division of Energy, 1-800-334-6946 (toll-free from anywhere in Missouri).
- ◆ Energy Efficiency and Renewable Energy Clearinghouse: 1-800-363-3732 (toll-free from anywhere in the United States). Excellent printed information on all aspects of energy conservation and alternative energy resources. Call, or write: Renewable Energy Information, 3048 Merrifield, VA 22116. Operated by the U.S. Department of Energy.

Manufactured Housing Division

This organization—part of the Missouri Public Service Commission—assists in the supervision and regulation of the state's manufactured housing industry and protects the health and safety of manufactured home buyers and residents. Mobile home manufacturers, dealers and installers must be licensed and must warrant their work; under certain circumstances, the division will accept and resolve complaints against licensees.

The division's regulations include installation standards of utilities, drainage, blocking, skirting and tie-down. More information can be obtained by calling or writing:

Missouri Manufactured Housing Inst.
4748 Country Club
Jefferson City, MO 65109
(573) 636-8660

Weatherization Assistance Program

The Department of Natural Resources' Division of Energy administers a Weatherization Program, designed to assist low-income

individuals and households with repairs and energy-conservation improvements to their homes.

The program is operated by local contract organizations. For information about eligibility for the program and about program services, call the organization serving your area:

Community Services, Inc. of Northwest Missouri, 214 W. Third St., P.O. Box 328, Maryville, MO 64468. (660) 582-3114. (Atchison, Gentry, Holt, Nodaway and Worth counties.)

Delta Area Economic Opportunity Corp., Drawer E, Portageville, MO 63873. (573) 379-5701. (Dunklin, Mississippi, New Madrid, Pemiscot, Scott and Stoddard counties.)

East Missouri Action Agency, Inc., 403 Glendale, P.O. Box N, Park Hills, MO 63601. (573) 431-5191. (Bollinger, Cape Girardeau, Iron, Madison, Perry, St. Francois, Ste. Genevieve and Washington counties.)

Economic Opportunity Corp. of Greater St. Joseph, P.O. Box 3068, 817 Monterey, St. Joseph, MO 64503. (816) 233-8281. (Andrew, Buchanan, Clinton and DeKalb counties.)

Economic Security Corp. of Southwest Area, 305 Virginia, P.O. Box 207, Joplin, MO 64802. (417) 781-0352. (Barton, Jasper, McDonald and Newton counties.)

Green Hills Community Action Agency, 1506 Oklahoma Ave., P.O. Box 278, Trenton, MO 64683. (660) 359-3907. (Caldwell, Daviess, Grundy, Harrison, Linn, Livingston, Mercer, Putnam and Sullivan counties.)

Central Missouri Counties' Human Development Corp., 807-B N. Providence, Columbia, MO 65203. (573) 443-8706. (Audrain, Boone, Callaway, Cole, Cooper, Moniteau and Osage counties.)

Urban League of Metropolitan St. Louis, 3701 Grandel Square, P.O. Box 8138, St. Louis, MO 63156. (314) 615-3610. (St. Louis City.)

Jefferson-Franklin Community Action Corp., P.O. Box 920, 4640 Yeager Rd., Hillsboro, MO 63050. (314) 789-2686. (Franklin and Jefferson counties.)

Dept. of Housing and Community Development, 11th Floor, City Hall, 414 East 12th Street, Kansas City, MO 64106. (816) 274-2201. (Clay, Jackson and Platte counties.)

Services Toward Empowering People, 7935 Page Blvd., St. Louis, MO 63133. (314) 863-0015. (St. Louis County.)

Missouri Ozarks Community Action, Inc., 306 S. Pine St., P.O. Box 69, Richland, MO 65556. (573) 765-3263. (Camden, Crawford, Gasconade, Laclede, Maries, Miller, Phelps and Pulaski counties.)

Missouri Valley Human Resource Community Action Agency, P.O. Box 550, 1415 S. Odell, Marshall, MO 65340. (660) 886-7476. (Carroll, Chariton, Johnson, Lafayette, Pettis, Ray and Saline counties.)

North East Community Action Corp., 16 N. Court St., P.O. Box 470, Bowling Green, MO 63334. (573) 324-2251. (Lewis, Lincoln, Macon, Marion, Monroe, Montgomery, Pike, Ralls, Randolph, St. Charles, Shelby and Warren counties.)

Northeast Missouri Community Action Agency, P.O. Box 966, 1011 S. Jamison, Kirksville, MO 63501. (660) 665-9855. (Adair, Clark, Knox, Schuyler and Scotland counties.)

Ozark Action, Inc., P.O. Box 588, 710 E. Main St., West Plains, MO 65775. (417) 256-6147. (Douglas, Howell, Oregon, Ozark, Texas and Wright counties.)

Ozarks Area Community Action Corp., 215 S. Barnes, Springfield, MO 65802. (417) 864-3460. (Barry, Christian, Dade, Dallas, Greene, Lawrence, Polk, Stone, Taney and Webster counties.)

South Central Missouri Community Action Agency, P.O. Box 6, Old Alton Rd., Winona, MO 65588. (573) 325-4750. (Butler, Carter, Dent, Reynolds, Ripley, Shannon and Wayne counties.)

West Central Missouri Community Action Agency, P.O. Box 125, 106 W. 4th St., Appleton City, MO 64724. (660) 476-2185. (Bates, Benton, Cass, Cedar, Henry, Hickory, Morgan, St. Clair and Vernon counties.)

Mobile Home Energy Conservation Checklist

Items to Consider When Purchasing and Setting up a Mobile Home

- ☐ Buy a model with extra insulation and other energy-conservation features.
- ☐ Check the data plate for the correct wind, roof load, and climatic zones.
- ☐ Make sure your furnace size is correct for your area.
- ☐ Place the mobile home on a foundation that is adequate for your area.
- ☐ Make sure the mobile home is properly leveled.
- ☐ Locate the home so the active areas (kitchen, living room) are to the south and inactive areas (bedrooms) are to the north.
- ☐ Situate the home correctly with respect to landscaping, particularly winter windbreaks and summer shading on the west.

Items That Cost Nothing

- ☐ Keep doors and windows closed and latched in winter.

- ☐ Set furnace thermostat as low as comfortable.
- ☐ Set back furnace thermostat at night and when away.
- ☐ Close fireplace or woodstove damper when not in use.
- ☐ Open drapes on winter days.
- ☐ Perform routine furnace maintenance.
- ☐ Keep furnace return air paths free from obstructions.
- ☐ Turn off furnace pilot in summer.
- ☐ Open windows for ventilation when outside temperature permits.
- ☐ Close drapes on summer days.
- ☐ Perform routine air conditioner maintenance.
- ☐ Set water heater thermostat as low as convenient.
- ☐ Wash clothes with cold or warm water and rinse with cold water.
- ☐ Drain water heater sediment periodically.
- ☐ Turn off lights and appliances when not in use.
- ☐ Use task lighting.
- ☐ Dry full loads in clothes dryer and use clothesline when acceptable.
- ☐ Cook with small appliances rather than oven.
- ☐ Clean refrigerator coils regularly.
- ☐ Maintain refrigerator at 35° - 37° F and freezer at 0° - 5° F.
- ☐ Keep refrigerators and freezers full and defrost regularly.
- ☐ Set air conditioner thermostat no lower than 78° F in summer and use a fan.
- ☐ Raise thermostat setting or turn off air conditioner when away from home.

Items That Are Inexpensive and Usually Have Quick Paybacks

- ☐ Fix broken window glass.
- ☐ Fill large holes, particularly around penetrations.
- ☐ Make sure windows and doors close properly.
- ☐ Repair siding, roofing, and bellyboard.
- ☐ Caulk window frames, door frames, around other openings, and at interior panel joints.
- ☐ Weatherstrip windows, doors, and access panels.
- ☐ Install insulating gaskets at electric switches and outlets.
- ☐ Seal kitchen and bathroom exhaust systems in winter.
- ☐ Install plastic storm windows.
- ☐ Install nightlight on timer to trick thermostat.
- ☐ Repair gas in heating duct if accessible.
- ☐ Install heating-duct insulation if duct is exposed.
- ☐ Install scoops at heating duct "dead ends."
- ☐ Replace furnace filters yearly.
- ☐ Seal cooling system penetrations in winter.
- ☐ Replace evaporative cooler pads yearly.
- ☐ Fix water leaks.
- ☐ Install low-flow showerheads.
- ☐ Install additional water heater insulation.
- ☐ Install hot water pipe insulation where pipe is exposed; use heat tape if necessary.
- ☐ Use fluorescent lighting where acceptable, and use low wattage bulbs where acceptable.
- ☐ Buy efficient light bulbs—the more lumens produced per watt, the more efficient the bulb—check the ratings on the package.
- ☐ Replace refrigerator gasket if needed.

Items That Are Expensive Yet Usually Have Quick Paybacks

- ☐ Replace doors and windows that won't close.
- ☐ Insulate floor if existing floor insulation is inadequate.
- ☐ Replace furnace burner orifices if oversized.
- ☐ Install automatic night setback thermostat.
- ☐ Provide outside combustion air for furnace and water heater if not present.
- ☐ Use room heaters and turn down central heating system.
- ☐ Replace electric resistance heaters with gas-fired heaters (room heaters, water heaters, and furnaces).
- ☐ Replace air conditioner with energy-efficient model.
- ☐ Replace refrigerator and freezer with very efficient models.

Items That Are Expensive and Usually Have Long Paybacks

- ☐ Install permanent storm windows.
- ☐ Install draperies (with valances) or nighttime insulation systems for windows.
- ☐ Replace exterior doors with units that are insulated and have thermal break.
- ☐ Install storm doors.
- ☐ Install well-sealed, well-insulated skirting with operable vents.
- ☐ Change furnace thermostat location if improperly located.
- ☐ Install summer exterior shading or landscaping.
- ☐ Install air-lock entryway, particularly at main entrance.
- ☐ Solar water heating.
- ☐ Passive or active solar heating retrofits.
- ☐ Re-insulate ceiling.
- ☐ Re-insulate walls.

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